GEOMATRIX

Corrective Measures Study Work Plan
Van Waters & Rogers Inc.
4120 Buckingham Place

Omaha, Nebraska

EPA ID # NED986375327

Prepared for:

Van Waters & Rogers Inc.
6100 Carillon Point
Kirkland, Washington 98033

December 1999

Project No. 004132.000.0

Geomatrix Consultants

10801 Wayzata Boulevard, Suite 270
Minneapolis, Minnesota 55305
(612) 544-4614 • FAX (612) 544-4874

GEOMATRIX

December 10, 1999
Project 004132.000.0

RECD
DEC 14 1999
RCAP

Mr. William F. Lowe
U.S. Environmental Protection Agency
901 North 5th Street
Kansas City, KS 66101

Subject: Revised CMS Work Plan
Van Waters & Rogers Inc., 4120 Buckingham Place Facility
Omaha, Nebraska
EPA ID# NED986375327

Dear Mr. Lowe:

The CMS Work Plan for the referenced site is enclosed for your review and approval. The document has been revised in accordance with U.S.EPA's comments on the draft CMS Work Plan that were contained in correspondence to Van Waters & Rogers Inc. dated November 19, 1999.

If you have any questions, please do not hesitate to contact Jim Hooper at VW&R, 630-761-0486 or Eric Tollefsrud at 612-544-4614.

Sincerely yours,
GEOMATRIX CONSULTANTS, INC.

E. Tollefsrud

Eric Tollefsrud
Senior Hydrogeologist

Christopher Thompson, P. E.
Principal Engineer

ET:ke

Enclosure

cc: Mr. Jim Hooper, Van Waters & Rogers Inc.
Mr. Bill Gidley, Nebraska Department of Environmental Quality

GEOMATRIX

Corrective Measures Study Work Plan
Van Waters & Rogers Inc.
4120 Buckingham Place

Omaha, Nebraska

EPA ID # NED986375327

Prepared for:

Van Waters & Rogers Inc.
6100 Carillon Point
Kirkland, Washington 98033

Prepared by:

Geomatrix Consultants, Inc.
10801 Wayzata Boulevard, Suite 270
Minneapolis, Minnesota 55305
(612) 544-4614

December 1999

Project No. 004132.000.0

GEOMATRIX

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLES

FIGURES

APPENDIX

CORRECTIVE MEASURES STUDY WORK PLAN

Van Waters & Rogers Inc.
4120 Buckingham Place
Omaha, Nebraska
EPA ID # NED986375327

1.0 INTRODUCTION

This document presents the Corrective Measures Study (CMS) Work Plan for Van Waters & Rogers Inc. (VW&R) former Facility at 4120 Buckingham Place, Omaha, Nebraska (the "Facility"). The CMS Work Plan has been prepared under an agreement with the U.S. Environmental Protection Agency (U.S.EPA) following the Resource Conservation and Recovery Act (RCRA) corrective action process. Geomatrix Consultants, Inc. (Geomatrix) prepared this CMS Work Plan on behalf of VW&R pursuant to the April 27, 1993, Administrative Order on Consent (Docket No., VII-93-H-0011) (Order) entered into between the U.S.EPA and Univar Corporation, which owned the Facility at that time.

The scope of the CMS was outlined in a December 1, 1998, correspondence from VW&R to the U.S.EPA. The U.S.EPA provided comments on the scope of the CMS in a January 14, 1999, correspondence from the U.S.EPA to VW& R, and those comments have been incorporated into this Work Plan.

1.1 PURPOSE OF THE CMS

The purpose of the CMS is to identify, develop, evaluate, and recommend a corrective measure alternative(s) that are applicable to Facility conditions and will meet the corrective action objectives for the Facility. The corrective action objectives and the list of potential CM technologies contained in this work plan are essentially those presented to the U.S.EPA in the RCRA Facility Investigation (RFI) Report. The list of potential CM technologies was prepared by eliminating from consideration those technologies whose use is reasonably precluded by Facility and/or waste characteristics and retaining those technologies that may be applicable to known site characteristics. The list of CM technologies presented in the RFI has been augmented during the preparation of this Work Plan. Implementation of the CMS will entail description of the identified CM technologies and thorough evaluation of the technologies. The evaluation will utilize criteria provided in the Guidance on RCRA Corrective Action Decision Documents (U.S.EPA, 1991) and in the Advance Notice of Proposed Rulemaking pertaining to

Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities (U.S.EPA, 1996).

1.2 OBJECTIVE OF THE CMS WORK PLAN

The CMS Work Plan describes the approach that will be used to evaluate CM technologies that are potentially applicable to achieve corrective action objectives at the Facility. The Work Plan includes the following information:

1. Proposed corrective action objectives developed for the Facility.
2. Specific potential CM technologies identified for the Facility.
3. Corrective-action evaluation criteria and a discussion of how these criteria will be applied in the evaluation process.
4. The plan for obtaining additional Facility- and technology-specific data during implementation of the CMS for a thorough evaluation of certain CM technologies.
5. The overall project approach, including an implementation schedule.

2.0 CORRECTIVE ACTION OBJECTIVES

Corrective action objectives for the Facility target the soil and groundwater impacted by constituents of concern (COCs). The COCs in soil include the chlorinated hydrocarbons and chlorinated pesticides listed in Table 1. The COCs in groundwater include the chlorinated hydrocarbons listed in Table 1. The list of COCs was identified and developed in the RFI. The corrective action objectives are based on the protection of human health and the environment, Facility-specific information gathered during the RFI, U.S.EPA guidance, and the requirements of applicable statutes.

2.1 SOIL

The corrective action objective for soil is to achieve an acceptable level of risk to human health and to prevent transfer of COCs from soil to other media that would result in unacceptable risk. The RFI identified an area of shallow soil (i.e., less than 12 feet below ground surface [bgs]) where COCs in the soil should be addressed to reduce the potential risk to human health to acceptable levels. COCs in deep soil pose a potential risk via transfer of COCs to groundwater. Based on Facility characteristics, corrective action objectives for this deep soil are addressed in this Work Plan via the corrective action objectives for groundwater.

Corrective action objectives for shallow soil are based on chemical concentrations that are considered representative of the average concentration to which an individual might be exposed over an extended period (i.e., "exposure point concentrations"). Exposure point concentrations were estimated using Facility data and are based on the 95% upper confidence limit (95% UCL) of the arithmetic mean to account for uncertainty in estimating the mean concentrations. Areas of the Facility that contribute most significantly to the overall risk were identified by comparing the exposure point concentration for each of the COCs to criteria prescribed by the U.S. EPA for an adult industrial worker. Noncarcinogenic and carcinogenic toxicity criteria were based on values provided in the U.S. EPA Integrated Risk Information System (IRIS) database (U.S.EPA, 1999). Target risk levels of 1×10^{-5} (as an aggregate target risk level for all chemicals, risk for individual chemicals did not exceed 3×10^{-6}) and hazard index of 1 were used for carcinogenic and noncarcinogenic chemicals, respectively. The area of the Facility that requires corrective action, based on the identified risk, is illustrated on Figure 1.

2.2 GROUNDWATER

Based on the concentrations of COCs in the groundwater, it was concluded in the RFI that the impacted groundwater constitutes a low long-term risk to human health and the environment. The corrective action objective for groundwater is to further minimize the potential long-term risk by addressing migration of impacted groundwater toward potential receptors and to prevent exposure to impacted groundwater. Potential receptors include downgradient surface water bodies and future users of impacted groundwater.

3.0 CORRECTIVE MEASURES TECHNOLOGIES

The corrective measures technologies to be evaluated in the CMS were first identified in the RFI. The list of technologies has been modified slightly and is presented in Table 2. A brief description of each technology is provided in the following section. The CMS Report will include a Facility-specific description of the listed technologies.

3.1 SOIL

An acceptable level of risk as it relates to impacted soil will be achieved by limiting the potential exposure pathways to the subject soil or by reducing the concentration of the COCs in the soil. In the CMS, "soil" pertains to "shallow" soil at a depth bgs of 12 feet or less. The "deep" soil is included in the section pertaining to groundwater.

The technologies have been grouped into four approaches that can achieve the objectives for soil. The approaches are as follows:

1) In situ treatment technologies that treat impacted soil in place to reduce the concentration of the COCs.

2) Ex situ treatment technologies, where impacted soil is excavated and treated at the Facility to reduce the concentration of the COCs or is disposed off-site.

3) Barrier technologies, where a barrier is emplaced between impacted soil and potential receptors, reducing potential risk to acceptable levels.

4) Institutional controls that reduce the potential for exposure to impacted soil and thereby reduce the potential risk to acceptable levels.

The CM technologies are described in more detail as follows.

3.1.1 In Situ Treatment Technologies

The following treatment technologies address impacted soil in place. The in-situ technologies generally will not require soil excavation but may require removal of concrete foundations or other current soil covers.

<u>Monitored Natural Attenuation</u>

Natural processes such as dilution, dispersion, volatilization, biodegradation, adsorption, and chemical reactions within the soil are allowed to reduce COC concentrations to acceptable levels. This requires a good understanding of the basic soil chemistry and monitoring of certain physical and chemical parameters associated with the degradation of both chlorinated hydrocarbons and chlorinated pesticides.

<u>Chemical Oxidation</u>

The COCs can be oxidized utilizing reagent solutions delivered to the soil matrix through injection points. Some reagents utilized can also result in an oxygen and nutrient rich environment allowing indigenous microorganisms to biodegrade residual contaminants. Complete destruction of the contaminants results in the breaking of the carbon-carbon bonds and results in the formation of carbon dioxide and water. The introduction of the reagent is accomplished through multiple injection points placed throughout the impacted soils. The most important requirement for successfully treating the soils is the introduction of the reagent throughout the impacted soils in a time frame defined by the rate of the chemical reactions.

Soil Vapor Extraction (SVE)

The COCs can be extracted from the soil matrix by application of a vacuum with vacuum extraction well screens and electric blowers and controls. Under the influence of an applied vacuum, the COCs that are volatile will be collected at the well screens and then conveyed to the blower and possible emission controls at the ground surface. The extracted COC-laden airflow is made up by airflow into the contaminated soil zone from the ground surface or soil outside the contaminated zone. The SVE system may also provide for enhanced biodegradation of the COC in-situ through the introduction of basic nutrients into the contaminated zone (such as oxygen) and by enhancement of the environmental conditions (such as temperature) required for the degradation of the COCs.

Phytoremediation

Plants can be used to remove, transfer, stabilize, and/or degrade the COCs in soil. The mechanisms of phytoremediation include enhanced rhizosphere biodegradation, phyto-extraction (also called phyto-accumulation), phyto-degradation, and phyto-stabilization.

3.1.2 Ex Situ Treatment Technologies

Removal of impacted soil prior to treatment can aid in achieving the corrective action objectives by allowing the treatment technologies to be used more effectively. Excavated soil can be amended to increase the permeability or otherwise enhance the soil to be treated. Low permeability of Facility soil poses a significant limitation on in situ technologies. Soil could be removed by excavating with standard construction equipment. However, excavated soil must be managed through treatment and/or disposition techniques. Potential treatment and disposition techniques are listed in Table 2 and are described as follows.

Enhanced bioremediation

The activity of naturally occurring microbes is stimulated by circulating water-based solutions through impacted soil to enhance in situ biological degradation of the COCs. Nutrients or other amendments may be used to enhance bioremediation and desorption.

In the presence of sufficient oxygen (aerobic conditions) and other nutrients, microorganisms will ultimately convert many organic contaminants to carbon dioxide, water, and microbial cell mass. In the absence of oxygen (anaerobic conditions), the chlorinated hydrocarbons will be ultimately metabolized to methane, ethane, ethene, carbon dioxide, and trace amounts of hydrogen gas.

Chemical Oxidation

The oxidation of the COCs to carbon dioxide and water can be accomplished in excavated soils in the same manner as in the in-situ soils as described above. The same parameters and requirements apply regarding injection of the reagent and timing of the reactions. Excavated soil can be amended to improve the distribution of chemical reagent throughout the soil.

Soil Vapor Extraction

As with in-situ vacuum extraction, a vacuum is applied to an aboveground soil pile through extraction points to create a pressure/concentration gradient that induces gas-phase volatiles to be removed. Excavated soil can be amended to increase air permeability and enhance the effectiveness of SVE in the Facility soils.

Thermal Desorption

Excavated soil can be heated through a process train to volatilize water and the COCs from the soil. A carrier gas or vacuum system transports volatilized water and organics to a gas treatment system. Two common thermal desorption designs are the rotary dryer and thermal screw. A primary fuel is required to sustain the temperature required. This treatment of soils can be performed by a mobile system brought to the Facility on a temporary basis.

Incineration

Incineration of the soils is similar to thermal desorption but is performed at high temperatures, 870 to 1,200 °C (1,400 to 2,200 °F). The COC are volatilized and destroyed. A primary fuel is required to sustain the process temperatures. The destruction and removal efficiency (DRE) for properly operated incinerators can exceed 99.99%. As with thermal desorption, off gases and combustion residuals may require control and treatment.

Disposal

It is possible to dispose of the soil in a permitted off-site treatment and/or disposal Facility. Some pretreatment of the impacted soil (using one of the techniques described above) may be required to meet land disposal restrictions (LDRs) for landfills. Indemnification for the disposal is sometimes available from the disposal Facility.

3.1.3 Barrier Technologies

Barriers such as a soil cap or cover can reduce the potential for exposure to underlying soil and can essentially eliminate the potential soil to air migration pathway. This approach also provides some benefit in reducing vertical infiltration of water into soil. Barriers can range from a one-layer system of vegetated soil to a complex multi-layer system of soils and geosynthetic materials. This approach can be used to create a land surface that can support vegetation, be paved, and/or be used for other purposes such as building foundations. The following types of barriers can be used.

Soil Cap

A designed thickness of clean soil is placed over the surface of impacted soil. The barrier eliminates or reduces direct contact, minimizes fugitive dust emissions, and may assist in reducing volatile gas emissions.

Asphalt/Concrete Cap

A more effective single-layer cap than plain soil would be composed of concrete or bituminous asphalt. This barrier eliminates direct contact, dust emissions, and volatile gas emissions. An asphalt or concrete cap would also reduce vertical infiltration of water into soil that could mobilize the COCs from the shallow soil.

RCRA Subtitle C Cap

The RCRA C multilayered cap is a baseline design that consists of an upper vegetative (topsoil) layer, a drainage layer, and a low permeability layer which consists of a synthetic liner over 2 feet of compacted clay. The compacted clay liners are effective if they retain a certain moisture content but are susceptible to cracking if the clay material is desiccated.

3.2 GROUNDWATER

The low long-term risk from impacted groundwater can be minimized by addressing migration of impacted groundwater to potential receptors and by preventing exposure to impacted groundwater through consumptive use. Potential technologies for addressing migration of impacted groundwater include the following:

1) In situ treatment of the groundwater
2) Extraction and ex situ treatment
3) Containment, either hydraulic, physical, or chemical
4) Institutional controls.

Based on the distribution and characteristics of the COCs in groundwater, the CM technologies to be evaluated for groundwater include those that will also address deep soil. In the CMS, deep soils are those in the S Stratified Unit that may pose a risk of transfer of COCs from soil to groundwater.

3.2.1. In Situ Treatment Technologies

The following technologies address groundwater corrective-action objectives without pumping groundwater to the ground surface.

Enhanced bioremediation

The rate of biodegradation of COCs is enhanced by augmenting the concentration of electron donors and nutrients in the groundwater, and reducing oxygen concentration in the targeted treatment area. Groundwater augmentation in an anaerobic system is best-accomplished in-well to minimize the introduction of oxygen.

Air Sparging/Vapor Extraction

The COCs in groundwater are volatile and may be removed through the action of introduction of compressed air into the saturated soils. The air movement upwards and through the saturated soils will allow for partitioning of the organics into the vapor phase. The physical action of the expanding and rising injected air and the heat of the injected air will cause volatilization of the COCs. The air is injected through small-diameter well screens below the water table or within the saturated soils. Vapor extraction wells are placed to extract the COC-laden air in the unsaturated soil and transport it to the surface for control and/or treatment.

Reductive Dechlorination

The COCs can be degraded to ethene and ethane abiotically through the application of a zero valence metal (such as iron) to the saturated zone. Metal enhanced reductive dechlorinization is a corrective measures technology that has been applied at a number of sites with COCs similar to this site with good results. The application at this site would require placement of the metal into the soils at depths between 60 and 80 feet.

Chemical Oxidation

The COCs can be oxidized utilizing proprietary reagent solutions delivered to the soil/groundwater matrix through injection points. Some reagents utilized can also result in an oxygen and nutrient rich environment allowing indigenous microorganisms to biodegrade residual contaminants. Complete destruction of the contaminants results in the breaking of the carbon-carbon bonds and results in the formation of carbon dioxide and water. The introduction of the reagent is accomplished through multiple injection points placed throughout the impacted soils. The most important requirement for successfully treating the impacted media is the introduction of the reagent throughout the impacted zone in a timeframe defined by the rate of the chemical reactions.

Monitored Natural Attenuation

Natural subsurface processes such as dilution, volatilization, biodegradation, adsorption, and chemical reactions with subsurface materials are allowed to reduce COC concentrations to acceptable levels. Groundwater is monitored periodically to track the degradation rate, stability of the area of impacted groundwater, and the presence of the products of attenuation. This approach eliminates the transfer of COCs from groundwater to other media that occurs with ex situ treatment technologies and can accomplish the same objectives over similar timeframes.

3.2.2 Ex Situ Treatment Technologies

Extraction of groundwater can be used to achieve corrective action objectives. Groundwater can be extracted using pumping wells or using a high vacuum system in wells to simultaneously remove a combination of groundwater and vapor from the subsurface. The extracted groundwater (and vapor, if necessary) is then treated by one of the following technologies.

Bioreactor

COCs in extracted groundwater are put into contact with microorganisms in attached or suspended growth biological reactors. In suspended systems, such as activated sludge, COC-laden groundwater is circulated in an aeration basin. In attached systems, such as rotating biological contractors and trickling filters, microorganisms are established on an inert support matrix.

Liquid phase carbon adsorption

Groundwater is pumped through a series of canisters or columns containing activated carbon to which dissolved organic adsorb. Periodic replacement or regeneration of saturated carbon is required.

Air stripping

Volatile organics are partitioned from extracted groundwater by increasing the surface area of the impacted water exposed to air. Aeration methods include packed towers, diffused aeration, tray aeration, and spray aeration. Carbon adsorption can be used to treat vapor phase organic compounds.

UV Oxidation

Ultraviolet (UV) radiation, ozone, and/or hydrogen peroxide are used to destroy COCs as water flows into a treatment tank. If ozone is used as the oxidizer, an ozone destruction unit is used to treat collected off gases from the treatment tank and downstream units where ozone gas may collect, or escape.

3.2.3 Containment Technologies

Containment measures prevent, or significantly reduce, the migration of impacted groundwater. Technology options are as follows.

Hydraulic barrier

Groundwater pumping is a commonly used method for preventing the migration of impacted groundwater. Groundwater is pumped at a rate and from locations suited to capture the area of impacted groundwater under the prevailing hydraulic conditions. Recovered groundwater must be contained, treated, and discharged off-site or downgradient of the recovery wells to have a net loss of groundwater from the targeted area.

Physical barrier

This approach laterally encapsulates impacted groundwater with a subsurface barrier. The barrier can be constructed by either excavating and filling a trench with low permeability material or by the subsurface injection of material designed to reduce water flow and/or consolidate the formation. The depth of the barrier required at the Facility would be at the extreme depth limitation of this technology.

Chemical barrier

A permeable reactive barrier is situated to intersect the flow of impacted groundwater. The presence of iron or other reactive materials in the barrier react with the constituents of the impacted groundwater as they pass through the barrier. The depth of the barrier required at the Facility would be at the extreme depth limitation of this technology.

3.3 INSTITUTIONAL CONTROLS

Institutional controls provide a means to control exposure to impacted soil and groundwater. This is accomplished by limiting use or activities that could result in exposure and serving as a mechanism to notify appropriate parties of the presence of impacted soil and groundwater. Issues to be evaluated include the type of control to be used, the effectiveness of the control, and the authority, capability and willingness of the appropriate entities to implement, maintain, and monitor the control.

Types of institutional controls include zoning, well drilling restriction areas, deed restrictions, and deed notifications. Institutional controls are intended to ensure that the situation (i.e., no exposure) does not change without an accompanying evaluation of risk.

4.0 EVALUATION OF CM TECHNOLOGIES

Each corrective measure technology listed in Table 2 will be evaluated as a Facility specific technology using the criteria listed in Table 3 (U.S.EPA, 1991; U.S.EPA, 1996). Facility characteristics will be used to assess the installation work, materials volumes, sampling and analysis needs, materials of construction, flow rates, energy use, and other relevant issues that would be required to make the technology effective under conditions anticipated at the Facility. Based on the results of the evaluation, a corrective measure will be recommended. The corrective measure may be a combination of the identified technologies. The recommendation will include a summary table to highlight tradeoffs among health risks, environmental effects, and other pertinent factors applicable to the evaluation of the technologies. A discussion of the four general standards and five subsequent selection decision factors that will be used for the technology evaluation is provided below.

4.1 GENERAL STANDARDS FOR CORRECTIVE MEASURES

Each corrective measure considered for use at the Facility meets the general standards listed in Table 3. The degree to which each technology meets the standards and the difficulty in adapting a technology to meet the standards under Facility conditions will be comparatively evaluated.

4.1.1 Protection of Human Health and the Environment

Each alternative will be evaluated in terms of how it provides human health and environmental protection through either reduction of the toxicity or mass of the COCs or through protection by elimination of the exposure pathway. This will entail assessing the performance of the alternative with regard to how it would eliminate, reduce, or control risk through the extent of treatment of the COCs, engineering controls, or institutional controls.

4.1.2 Attainment of Media Cleanup Standards

The evaluation of the technologies for soil will be based on the extent to which the technology eliminates the potential for exposure to residual COC concentrations that would result in an unacceptable risk.

The evaluation of the groundwater technologies will be based on the extent to which the technology will address migration of COC-laden groundwater and prevention of future exposure through consumptive use.

4.1.3 Source Control

The evaluation will address how the alternatives reduce or eliminate to the maximum extent possible further releases. The primary source of the COCs was effectively removed when the Facility was decommissioned. Each corrective measure for soil will be evaluated based on the extent to which the technology will address the potential transfer of COCs from shallow soil to deep soil. Each corrective measure for groundwater will be evaluated based on the extent to which the technology will address the potential for downgradient migration of COCs.

4.1.4 Compliance with Standards for Management of Wastes

Each alternative will be assessed to identify how wastes will be managed in a protective manner while corrective measures are conducted. Each technology that is described and defined for the Facility would be implemented in a manner that is consistent with all pertinent regulations and standards for waste management (for those technologies that generate waste). Waste generated by the potential technologies will be managed within the current framework of federal, state and local regulations. This evaluation will relate to the complexity and resultant cost of the waste management requirements.

4.2 Selection Decision Factors

The technologies will be comparatively evaluated using the selection decision factors.

4.2.1 Long-Term Reliability and Effectiveness

Information on the reliability of each corrective measure will be evaluated and comparisons will be made between alternatives. This will include evaluating the operation and maintenance requirements and demonstrated reliability of the technologies through actual case studies and other similar site-specific results. This also includes an evaluation of the magnitude of the COC reduction through treatment or exposure route elimination and an evaluation of the generation of possible daughter products of the COC that may also become a COC.

Technologies requiring frequent and/or complex operation and maintenance activities will be regarded as less reliable than technologies requiring little or straightforward operation and maintenance. The availability of labor and materials to meet these requirements will also be considered.

Long-term effectiveness issues that will be addressed include: 1) reduction of total mass of COCs in the environment, 2) transfer of COCs to another media or location, 3) long-term impact on current and future uses of the property, 4) level of confidence in future use of the property, and 5) the length of time needed to achieve the corrective action objectives.

An additional effectiveness criterion will be the compatibility of the technology, and its assumed outcome, on the future use of the Facility (U.S.EPA, 1996). This evaluation will require assumptions regarding the possible range of future site uses including zoning and neighboring property use.

4.2.2 Reduction of Toxicity, Mobility, or Volume of Wastes

This portion of the evaluation will address the following:

1. Treatment process used and materials treated
2. Amount of hazardous materials destroyed or treated
3. Degree of expected reduction in toxicity, mobility, or volume
4. Degree to which treatment is reversible
5. Type and quantity of residuals remaining after treatment

4.2.3 Short Term Effectiveness

Each alternative will be evaluated in terms of mitigation of potential exposure to residual contamination and protection of human health both during and after implementation of the corrective measures. The evaluation will describe the levels and characterization of COCs at the Facility, potential exposure routes and potentially affected populations. Each alternative will be evaluated to determine the level of exposure to COCs and their reduction over time. Protection of the community and protection of on-site workers will be considered when evaluating short-term effectiveness.

Each corrective measure will be evaluated in regard to safety. This will include threats to the safety of nearby communities and environments as well as those to workers during implementation. Factors that will be considered include the risk of exposure to hazardous substances.

4.2.4 Implementability

Implementability of each corrective measure will be described in the following terms:

1. Ability to construct and operate the technology

2. The time required to achieve a given level of response

3. Ease of undertaking additional corrective measures if necessary

Constructability may include such factors as location of underground utilities, depth to the water table, depth of the impacted materials targeted by the remedy, heterogeneity of subsurface materials, compatibility with ongoing operations, and size and locations of the Facility. External factors affecting constructability, such as the need for special permits or agreements, equipment availability, and the location of suitable off-Facility treatment or disposal a facilities will be evaluated. The degree of uncertainty associated with construction and operation of a particular corrective measure will also be considered.

Two components of time will be evaluated. This will include the time it takes to implement a corrective measure and the time it takes to realize beneficial results.

In addition, the effects of federal, state and local regulations on the design, operation, or timing of each alternative will be evaluated. This will include evaluating the time and resources needed to coordinate with various involved parties and the ease of obtaining any necessary approval and permits. Administrative feasibility may also relate to whether the technology can be approved or permitted in the state.

4.2.5 Cost

An estimate of the cost of each corrective measure alternative will be developed, including both a capital cost estimate and operation and maintenance cost estimate. The total cost of each alternative will be expressed in current dollars.

5.0 DATA COLLECTION PLAN

Facility-specific data will be collected to facilitate the evaluation of corrective measures for both soil and groundwater. These include treatability data for shallow soil and hydraulic and geochemical data for groundwater within the S-Stratified Unit.

This section presents a description of the field and laboratory work including objectives, scope of work, and the procedures to be used for data management and interpretation. Upon completion of the work, the results will be incorporated into the evaluation process of the CMS. The results of the work will be documented in the CMS Report. If additional data collection is required to fully evaluate a technology, the data collection plan will be presented as an addendum to this work plan.

5.1 DATA COLLECTION OBJECTIVES

Soil data will be collected to evaluate the efficacy of treating impacted shallow soil by chemical oxidation. This evaluation will provide data useful in evaluating other ex situ treatment technologies such as their effectiveness and implementability.

Groundwater data will be collected to evaluate the highly variable hydraulic and chemical conditions of the S Stratified Unit. The majority of the COC mass is in this unit, and this unit is not as well characterized as the I Sand Unit. Data to be collected includes the thickness and hydraulic conductivity of sandy zones within the S Stratified Unit that were observed in the northwestern corner of the Facility, near MW1I. This information will be used to evaluate the potential for utilizing ex situ, in situ, or barrier technologies in the S Stratified Unit.

5.2 SCOPE OF WORK

The scope of work for the ex-situ soil treatment evaluation and for the hydraulic and geochemical evaluation of the S Stratified Unit is described in the following sections.

5.2.1 Ex Situ Soil Treatment Evaluation

This evaluation will consist of bulk soil sampling, a bench-scale treatability test, and data evaluation.

5.2.1.1 Bulk Soil Sampling

A bulk soil sample will be collected from an area of the shallow soil that represents the impacted soils that may require treatment. This sample will be collected in a manner to minimize volatilization of the COCs but is consistent with the effect on the soil of full scale excavation and stockpiling of the soil on-site. The specific sampling method will be developed in a Bench Scale Study Work Plan. This plan will be submitted to the U.S.EPA for approval prior to proceeding with the study. The soils will be analyzed for the presence of the COCs and for treatment parameters such as pH and iron. Specific analytical methods will be developed in the Bench Scale Study Work Plan.

5.2.1.2 Bench Scale Study

A pre-qualified vendor of the chemical oxidation technology will be selected to perform the bench scale study. The specific study protocols and methodologies will be developed in consultation with the vendor as a Bench Scale Study Work Plan.

5.2.1.3 Data Evaluation

The results of the bench scale study will be incorporated into the CMS report and will include information from the study including chain-of-custody documentation, photographs of the study, laboratory log book entries, laboratory reports of the analysis of the treated soil for the COC, and interpretation and conclusions by the vendor pertaining to the application to the full scale Facility soils.

5.2.2 Hydraulic and Geochemical Evaluation of the S Stratified Unit

This evaluation will consist of well installation, a pumping test, groundwater sampling, analysis, and data evaluation.

5.2.2.1 Well Installation

Three wells will be installed in the S Stratified Unit, RW1S, MW1S, and MW9S. The three wells will be screened within the S Stratified Unit and particularly targeting the sandy zone in the unit in the northwestern corner of the Facility. At MW1I, this zone is approximately 70 to 80 feet bgs.

RW1S will be a four-inch or five-inch diameter remediation well suitable for future use either pumping groundwater or injecting nutrients. RW1S will be located within 15 feet of MW1I. RW1S will be approximately 80 feet in depth with one .020 slot screen from 70 to 80 feet bgs. MW1S and MW9S will be two-inch diameter monitoring wells used with existing MW4S to monitor the S Stratified Unit during testing conducted using RW1S. Well spacing is based on an anticipated low hydraulic conductivity of the unit. MW1S will be installed within 15 feet of both MW1I and RW1S, and MW9S will be installed approximately 30 feet from RW1S. MW1S and MW9S will be installed on a line with MW4S.

Well installation methods and procedures, including well development and management of cuttings and fluids, will follow plans previously approved for use at the Facility and presented in the RFI Work Plan.

Hydrogeologic conditions will be logged during drilling to augment the existing hydrogeologic database for the Facility, particularly regarding the thickness and characteristics of the S Stratified Unit. In addition, this information will be used to ensure the wells do not extend below the base of the S Stratified Unit.

5.2.2.2 *Pumping Test*

The objective of the pumping test is to stress the S Stratified Unit sufficiently to obtain a meaningful, measurable response sufficient to calculate a hydraulic conductivity value. A pumping test will be conducted on the S Stratified Unit by pumping from RW1S and simultaneously monitoring water levels in MW1S, MW1I, MW4S and MW9S. The pumping rate will be based on the capacity of RW1S as observed during well development, the cost of disposal, and the objective of the test, which is to obtain a meaningful, measurable response. Based on characteristics of the unit, the flow rate will likely need to be relatively low, less than 1 gpm, to be able to sustain pumping over time. The flow rate will be measured and monitored frequently using an in-line flow meter to help maintain a constant discharge rate and to monitor discharge volume.

The pumped water may be disposed via storm sewer under a one-time discharge permit. If it is not possible to obtain a discharge permit or if treatment is required prior to discharge, the pumped water will be managed by pumping to a tank and treating the water. Treatment methods may consist of carbon adsorption or air stripping. The water will be tested for VOCs prior to discharge to the sewer.

The pumping test will be conducted until the delayed yield is observed, if possible. If necessary, the pumping test will be continued for up to five days. The benefits of the testing will not likely merit the cost and logistical difficulty of a longer test; if additional data are needed, slug tests will be conducted. Water levels will be monitored with an electronic data logger and pressure transducers and electric water-level meters. Measurements will be collected on a logarithmic time scale following the start of the test. Equipment will be calibrated and verification measurements will be made. Distance-drawdown analysis will be used to improve accuracy of aquifer parameter estimates.

If the S Stratified Unit is not sufficiently transmissive, it may not be possible to conduct the pumping test as designed because the drawdown at RW1S may exceed the thickness of the water column in the well at sustainable pumping rates. The capacity of RW1S will be evaluated prior to mobilizing for the pumping test, during well development. If this evaluation suggests the pumping test as described above will not be feasible, an alternative approach to estimating hydraulic conductivity of the unit will be conducted. This will consist of conducting slug tests in MW1S, MW4S, MW9S, and RW1S and using the data to calculate aquifer parameters. A rising head and a falling head test will be conducted at each location.

Pre-test activities will include measuring water levels and calibrating equipment. Dedicated measuring equipment will be used during the test. Top of casing elevations for RW1S, MW1S, and MW9S will be surveyed prior to the test. A rain gauge will be installed at the Facility during the test and monitored during and after rainfall events.

Samples of discharge water will be sampled and tested regularly during the test. Samples will be collected at the start of the test and at least once every 24 hours during the test. Samples will be submitted to a fixed laboratory for analysis of VOCs using Method 8260. Samples will also be tested in the field for dissolved oxygen, pH, specific conductance, and temperature. Drawdown measurements will be taken during the recovery portion of the test. The same logarithmic drawdown measurement schedule used during pumping will be used during recovery.

5.2.2.3 Groundwater Sampling and Analysis

After the wells have been developed and sufficient time has passed to allow the groundwater to equilibrate, the wells will be sampled for the groundwater COCs (Table 1) and attenuation parameters previously tested for at the facility. The sampling and analysis will be performed in a manner consistent with the well sampling and analysis performed for the RFI. Groundwater elevations will be measured in all of the wells at the Facility prior to sampling.

5.2.2.4 Data Evaluation

The hydrogeologic data collected from installing the wells will be used to augment the conceptual model of the hydrogeology of the Facility, with particular focus on the S Stratified Unit in the MW1I area. The pumping test data will be used to calculate the hydraulic conductivity of the sandy zone of the S Stratified Unit, for use in evaluating potential corrective measures and for design support.

6.0 PROJECT APPROACH

The overall project will be managed by the VW&R Project Manager responsible for the site, who will coordinate communications between VW&R, the USEPA, and Geomatrix. Geomatrix will serve as the prime environmental contractor, responsible for implementing the CMS activities described in this work plan. Senior personnel within Geomatrix are assigned to provide technical guidance and quality assurance during the CMS. Subcontractors and vendors needed to perform various tasks, such as bench scale testing, drilling and laboratory testing will be selected through a pre-qualification and bidding process conducted by Geomatrix.

6.1 SCHEDULE

The implementation schedule for the CMS is presented in Appendix A. Alterations to the activities described in this work plan may occur and impact the implementation schedule. If there is a significant change to the schedule for some reason, a revised schedule will be submitted to the U.S.EPA for approval.

6.2 REPORTS

Reports included in the CMS scope of work are progress reports and the draft and final CMS reports. These are described as follows.

6.2.1 Progress Reports

Quarterly progress reports will be submitted to the U.S.EPA. The progress reports will contain the following:

1. A description of work completed during the reporting period and an estimate of the percentage of the CMS completed
2. Summaries of findings
3. Summaries of changes made to the CMS during the reporting period
4. Summaries of contacts concerning or potentially affecting CMS activities with representatives of the local community, public interest groups, state government, or federal government during the reporting period
5. Summaries of problems or potential problems encountered during the reporting period
6. Action being taken to rectify problems
7. Changes in the project personnel
8. Projected work for the next reporting period
9. Copies of other relevant documentation.

6.2.2 CMS Report

A CMS Report will be prepared to identify a proposed remedy, explain the rationale for preference of the remedy, and describe all remedies that were analyzed. A draft CMS report will be submitted to the U.S.EPA for review and comment.

The draft CMS Report will include the following elements.

1. A description of the Facility, including a topographic map and preliminary diagrams of the proposed corrective measure

2. A summary of Facility background and risks:

   a) Brief overview of the Facility including current conditions and site history

   b) Brief summary of the RFI

   c) Overview of impacted media and constituents of concern

   d) Exposure scenario(s)

   e) Summary of current and potential risks

3. Summary and evaluation of the CM technologies:

   a) Detailed description of each technology as applied to the Facility

   b) Annotated evaluation matrix of the general standards and decision factors

   c) A final comparative analysis of corrective measure technologies.

   d) Description of the corrective measure or measures and rationale for selection

   e) Preliminary design criteria and rationale

   f) General operation and maintenance requirements

   g) Long-term monitoring requirements

4. Summary and evaluation of the proposed corrective measure, including the following:

   a) Description of the corrective measure(s) and rationale for selection

   b) Preliminary design criteria and rationale

   c) General operation and maintenance requirements

5. Design and implementation precautions such as the following:

    a) Special technical problems

    b) Additional engineering data required

    c) Permits and regulatory requirements

    d) Access, easements, rights-of-way

    e) Health and safety requirements

    f) Community relations activities

6. Cost estimates and schedules, including the following

    a) Capital cost estimate

    b) Operation and maintenance cost estimate

7. Preliminary schedule for design, construction, and operation

The CMS Report will be finalized incorporating comments received from the U.S.EPA on the draft CMS Report.

7.0 REFERENCES

U.S. EPA, 1991. Guidance on RCRA Corrective Action Decision Documents, Office of Research and Development, EPA/540/G-91/011.

U.S.EPA, 1996. Advance Notice of Proposed Rulemaking, Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities, 40 CFR Ch. 1, Federal Register, vol. 61, No. 85, May 1, 1996.

U.S.EPA, 1999. U.S.EPA Integrated Risk Information System (IRIS). On-line database downloaded May 1999.

GEOMATRIX

TABLE 1

CONSTITUENTS OF CONCERN

4120 Buckingham Place
Omaha, Nebraska

Soil
4,4'-DDD
Aldrin
alpha-Chlordane
gamma-Chlordane
Dieldrin
Heptachlor
Heptachlor Epoxide
1,1-Dichloroethene
Chloroform
Tetrachloroethene
Trichloroethene

Groundwater
Carbon Tetrachloride
1,1-Dichloroethene
cis-1,2-Dichloroethene
Tetrachloroethene
1,1,1-Trichloroethane
Trichloroethene

GEOMATRIX

TABLE 2

POTENTIAL CORRECTIVE MEASURES TECHNOLOGIES

4120 Buckingham Place
Omaha, Nebraska

Media	Technology Classification	Technology
Soil	In Situ Treatment Technologies	Monitored Natural Attenuation
		Chemical Oxidation
		Vapor Extraction
		Phytoremediation
	Ex Situ Treatment Technology [1]	Chemical Oxidation
		Enhanced Bioremediation
		Reductive Dechlorination
		Vapor Extraction
		Thermal Desorption
		Incineration
		Disposal
	Barrier Technologies	Surface Cover
		Asphalt/Concrete Cap
		RCRA Cap
	Institutional Controls	
Groundwater	In Situ Treatment Technologies	Enhanced Bioremediation
		Air Sparging/Vapor Extraction
		Reductive Dechlorination
		Chemical Oxidation
		Monitored Natural Attenuation
	Ex Situ Treatment Technologies [2]	Bioreactor
		Carbon Adsorption
		Air Stripping
		UV Oxidation
	Containment Technologies	Hydraulic Barrier [2]
		Physical Barrier
		Chemical Barrier
	Institutional Controls	

1 Assumes soil excavation

2 Assumes groundwater pumping or dual phase extraction

TABLE 3

EVALUATION CRITERIA FOR CORRECTIVE MEASURES

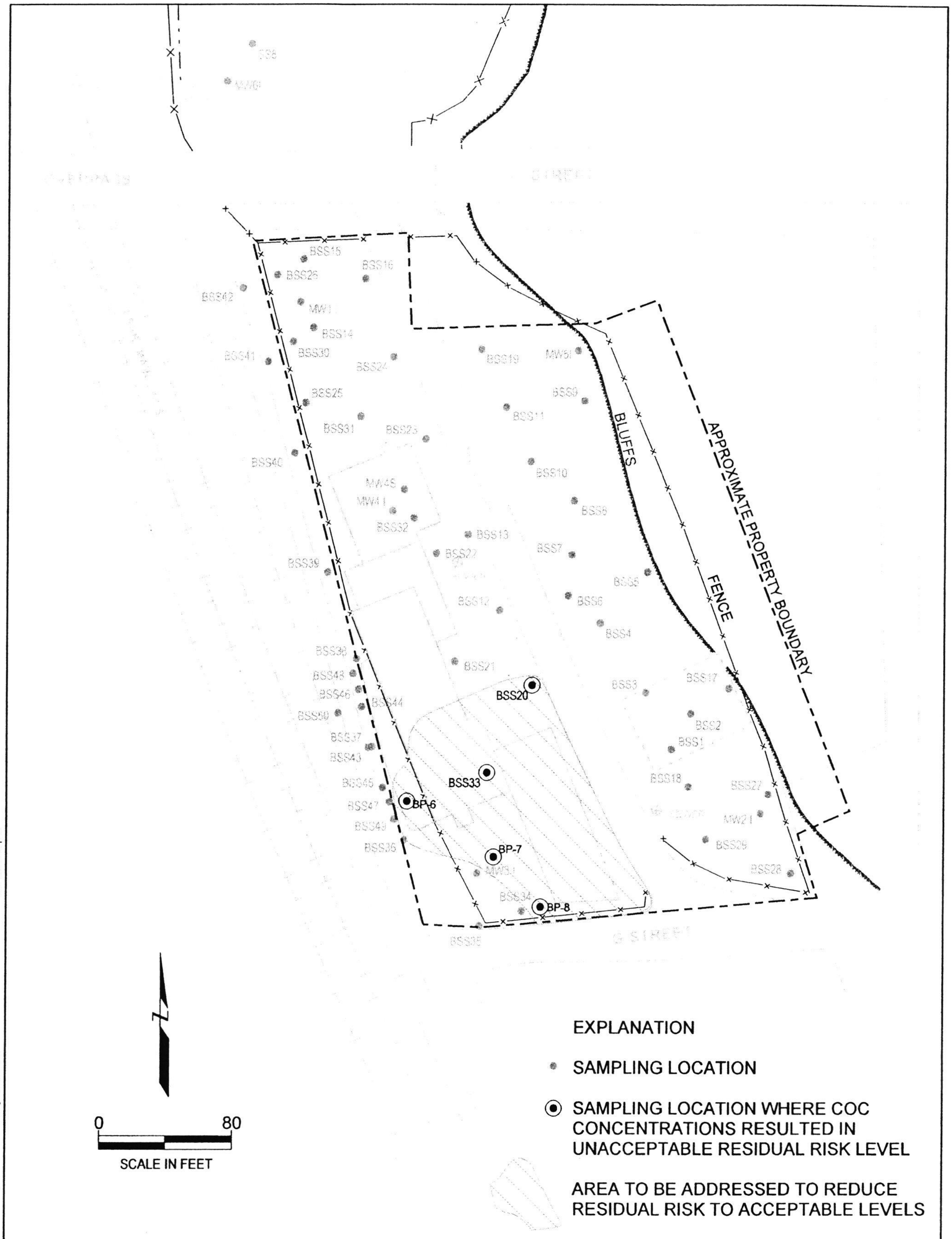
4120 Buckingham Place
Omaha, Nebraska

FOUR GENERAL STANDARDS FOR CORRECTIVE MEASURES

Overall protection of human health and the environment	Attain media cleanup standards	Control the sources of releases	Comply with standards for management of wastes
• How alternatives provide human health and environmental protection	• Ability of alternatives to achieve the media cleanup standards prescribed in the permit modification or enforcement order	• How alternatives reduce or eliminate to the maximum extent possible further releases	• How alternatives assure that management of wastes during corrective measures is conducted in a protective manner

FIVE SELECTION DECISION FACTORS

Long-term reliability and effectiveness	Reduction of toxicity, mobility, or volume of wastes	Short-term effectiveness	Implementability	Cost
• Magnitude of residual risk • Adequacy and reliability of controls	• Treatment process used and materials treated • Amount of hazardous materials destroyed or treated • Degree of expected reductions in toxicity, mobility, or volume • Degree to which treatment is irreversible • Type and quantity of residuals remaining after treatment	• Protection of community during remedial actions • Protection of workers during remedial actions • Environmental impacts • Time until remedial action objectives are achieved	• Ability to construct and operate the technology • Reliability of the technology • Ease of undertaking additional corrective measures if necessary • Ability to monitor effectiveness of remedy • Coordination with other agencies • Availability of off site treatment, storage and disposal services and specialists • Availability of prospective technologies	• Capital costs • Operating and maintenance costs • Present worth costs



MAP_WT3X.pen

23-NOV-1999 08:24 swessels
Q:\Minnesot\m4130s\m4133\m4133h\sca_9911_fig_01.dgn
\\SFPRNT2\Splash Hold Job-Nagomtrx.ctb

CHECKED:________

GEOMATRIX

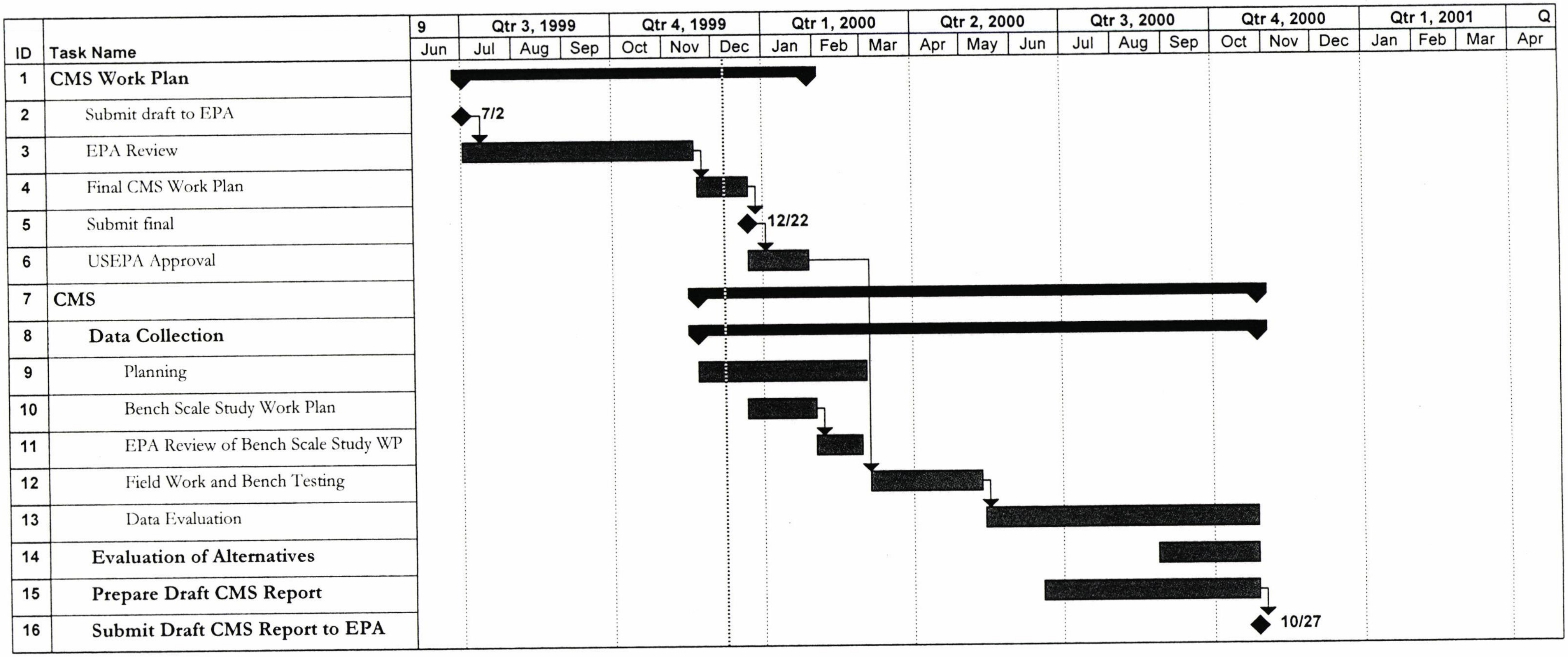
AREA TO BE ADDRESSED BY SOIL CORRECTIVE ACTION
4120 Buckingham Place
Omaha, Nebraska

Project No.
4133.000

Figure
1

GEOMATRIX

Corrective Measures Study Schedule
Van Waters & Rogers Inc.
4120 Buckingham Place, Omaha, Nebraska



P:\4132\CMS\CMS1299.MPP